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Good Aquaculture Practices for Cage Culture in Fresh Water

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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Fish, Fisheries and Aquaculture Sectional Committee had been approved by the Food and Agriculture Division Council.

Presently the average annual fish yield from small, medium and large reservoirs is 100, 75 and 50 kg/ha respectively, suggesting substantial scope to enhance yield through cage culture. Production of fingerlings in cages offers opportunity to produce fingerlings that can be used in stock enhancement programs for Indian reservoirs. Raising fingerlings from cages is profitable and, if practiced in Indian reservoirs, could solve the problem of providing fingerlings for stocking in those reservoirs. Furthermore, with prolonged, sustained and continued effort, assimilating the lessons learned, ICAR-CIFRI gained success in producing fingerlings in floating cages installed in different reservoirs across the country and developed guidelines. The present level of production of fry to fingerling and fingerling to marketable size fish of Indian major carps in cage with dimension of 5 m × 5 m × 3.5 m (productive volume 75 m^3), is 1.5 kg/m^3 and 10 kg/m^3 respectively whereas for Pangasius it would be 2.5 kg/m^3 and 50 kg/m^3.

At present around 14 000 cages are in operation in reservoirs in 15 states across the country. A number of candidate fish species like *Pangasianodon hypophthalmus*, GIFT Tilapia (Monosex), Jayanti Rohu (a var. of *Labeo rohita*), *Puntius javanicus, Labeo bata, Lates calcarifer, Macrobrachium rosenbergii*, besides air breathing fishes, ornamental fishes and murrels also has been tried in cages however only *P. hypophthalmus* is being produced at commercial level. B : C ratio of about 1.5 have been achieved by progressive states like Jharkhand and Chhattisgarh where Pangasius fetches better price. It is estimated that at an average production rate of 3 ton per cage, the cage culture is producing about 45 000 t of fish contributing around 15 percent of the total fish production from the reservoirs and providing employment at the rate of 7.4 lakh man-days/year. A preliminary study by ICAR-CIFRI in Jharkhand reservoirs revealed that cage farming contributes around 30 percent to livelihood of fishermen involved in cage farming.

The composition of the Committee, responsible for the formulation of this standard is given at Annex A.

In formulation of this standard, considerable assistance has been provided by Indian Council of Agricultural Research - Central Inland Fisheries Research Institute, Barrackpore (ICAR-CIFRI). Contribution of Dr. U. K. Sarkar, Principal Scientist and Head, (ICAR-CIFRI) is also duly acknowledged.

Indian Standard

GOOD AQUACULTURE PRACTICES FOR CAGE CULTURE IN FRESH WATER

1 SCOPE

This Indian Standard provides good aquaculture practices for cage culture in freshwater, cages, site and species selection, seed, feed and health management, safety measure, market, post-harvest facilities.

2 GOOD AQUACULTURE PRACTICES FOR CAGE CULTURE IN FRESHWATER

The sequence of procedures carried out for cage culture in freshwater is given under this clause.

2.1 Site Selection

The selection of site for cage culture is very important and success is in many occasions dependent on selection of proper site. The selection criteria are as follows:

a) Water with good quality, circulation and depth of water column should be at least 5 m or more.

b) In large and medium reservoirs, site should be in protected bays to evade strong wind action. In small reservoirs, the cage should be anchored in the deeper lentic sector avoiding direction of current flow through sluice gates and irrigation channel.

c) Site should be devoid of local and industrial pollution and it should be away from frequent disturbance of locals and grazing animals; devoid of algal blooms with less fouling and should be free from aquatic macrophytes.

d) Access to land and water transportation

e) It should not hinder the navigation if being practiced in the reservoir and should be secure place.

f) Site shall be avoided with frequent storm during culture period (March to October) based on the meteorological data

2.2 Types of Cages

Four types of cage are being used for cage aquaculture, fixed, floating, submersible and submerged. Fixed cage, is used in shallow water with water depth 1 to 3 m, consisting of net bag fitted in posts and normally put in the flow on streams, canals, rivers, rivulets, shallow lakes and reservoirs and should not touch the basin (Table 1). Fixed cages are comparatively in expensive, simpler, and smaller in size and shape and their use is also restricted. Floating cage, on the other hand, is basically supported by a floating frame, where from net bags are kept hanging in water without touching the basin. It is generally practiced in water bodies with depth of water more than 6 m.

2.3 Cage Materials and Their Procurement

The use of traditionally available materials for fabrication of cage assembly is highly warranted if the cage culture enterprise is to be sustained as economically viable. However, the intensification in cage farming needs the upgradation and modernization in materials as far as durability, economic viability in long term uses and sustenance of production system is concerned. Table 2 provides parameters for cage material and Table 3 provides for parameters for modular cages.

2.4 Fabrication of Cage Frame

The frame of the cage can be made from locally available bamboo, which is a cheaper option than wood, steel or polyvinyl chloride (PVC) and will last for at least 3 years, with 5-10 percent of the poles needing replaced. Two frames are required, one above water and the other below, to hold the floats firmly. Fully grown, cured bamboo poles at least 7.5 m long and 8-9 cm in diameter at the base are best suited to make the frame.

The GI/MS pipe frame would be lasting for more than 20 years as they are above water with acrylic painting in MS pipe. Two pipes of 3.7 – 5.0 cm diameter are placed 40 cm apart parallely, fitted with iron chequer plate cat walk (2-3 mm thickness) of square size 4 × 4 m or 5 × 5 m. Iron catwalk also will be painted with acrylic paint for more lasting as well as aesthetic look of the cage. The material specifications for frame fabrication are given in Table 4.

2.5 Floating the Cage Frame

The cages will float in water with the help of emptied iron drums, 4 in number, each of 22 kg weight, 200 litre in capacity with tight lids. The iron drums are tightened enough with the frame with two types of G.I. wire, one thicker (2 mm) being used at the central portion, and thinner one (1.5 mm) for encircling the drum with the frame at the end portions. The drums are painted with acrylic paint prior to setting in between the frames. It is observed that, only 16 cm of the drum portion remains under water out of 58 cm diameter during final stage of working. Now, the frame with floats is tied to the site of selection and affixed on water with anchors.

Table 1 Type of Cages

(*Clause* 2.2)

Sl No.	Type of Cage	Water Depth	Special Feature	Advantage	Disadvantage
(1)	(2)	(3)	(4)	(5)	(6)
i)	Fixed	Shallow water with depth of 1-3 metres	Net bag fitted to posts and is normally placed canals, rivers, rivulets, shallow lakes and reservoirs, without touching the bottom	Comparatively inexpensive and simple	Limited use and not with stand against adverse environmental conditions
ii)	Floating	Depth requires more than 6 metres	Supported by a floating frame such that the net bags hang in water without touching the bottom	User friendly	Withstand against adverse environmental conditions if site is ideal.

Table 2 Cage Material

(*Clause* 2.3)

Sl No.	Name of the Materials	Physical Parameters of the material	For Raising Fry to Fingerlings	For Raising Fingerlings to Table Size
(1)	(2)	(3)	(4)	(5)
i)	Bamboo	Poles should be straight, rigid and light in weight having 7.5 metres length, 8-9 cm diameter, wall thickness 2.5 cm at the base	Cage of minimum size 4 m × 3 m × 2.5 m	Cage of minimum size 6 m × 4 m × 4 m or circular cages of minimum diameter 6m with depth 4 m
ii)	Galvanized (G.I)/ Mild Steel (MS) pipe	3.7 – 5.0 cm diameter, 3.15-4.0 mm, thickness, 6 m length	Cage of minimum size 4 m × 3 m × 2.5 m	Cage of minimum size 6 m × 4 m × 4 m or circular cages of minimum diameter 6 m with depth 4 m
iii)	Floats	Empty 200 L steel/iron/HDPE drums, tightened lids, 88 cm long, 180 cm in circumference, 58 cm in diameter, weight 22 kg (iron) / 8 kg (HDPE).	For bamboo framed (4 m × 3 m × 2.5m), 6 numbers, empty drums For GI/MS pipe frame (4 m × 3 m × 2.5 m), 8 empty drums fitted with 2 GI collar (6 mm thickness) with the frame	For bamboo framed (6 m × 4 m × 4 m),14 numbers, empty drums For G.I/M.S pipe frame (6m × 4m × 4m), 8 empty drums fitted with Two GI collar (6 mm thickness) with frame
iv)	Nut and bolts	Steel bolts, 18 cm long and 3cm in diameter to provide strength	Iron made, 120 numbers, 18 cm long and 3cm diameter	120 numbers, 18 cm long and 3 cm diameter
v)	Sinkers	Stones weighing 3 – 4 kg, tightened with the bamboo/GI/MS frame to help cages maintain their rectangular/ square shape. Eight sinkers are required per cage	For bamboo frame cages, 8 sinkers are required per cage For GI/MS pipe frame, sinkers are required per cage	For bamboo frame cages, 8 sinkers are required per cage For GI/MS pipe frame, sinkers are required per cage
vi)	Anchors	Stones weighing approx. 40-50 kg. Two such anchors are tied with good quality (thick, 16-24 mm) nylon rope to every corner of the frame, and another anchor is tied to the centre of each long side	As mentioned	As mentioned
vii)	Netlonhapas	Multifilament knotless nylon netlonhapas of High-density polyethylene (HDPE) nets. 24-30 mm mesh is required for bird prevention by covering hapas. HDPE nets, 20-24 mm mesh is required for predatory fish control	Multifilament knotless nylon netlonhapa of 6-10 mm mesh for each cage size of 4 × 3 × 2.5m	Multifilament knotless nylon netlonhapas of 20-24 mm mesh for cage size of 4 m × 4 m × 3.5 m or 5 m × 5 m × 4 m size with running nylon ropes (8 mm)
viii)	Netlon ropes	Netlon ropes of different thickness (6 mm to 24 mm) required for tightening, hanging, sinker hanging, anchoring, lining along the length and breadth of the netlonhapas.	As mentioned	As mentioned

Table 3 Requirements for Modular Cages for Raising fry to Fingerling, and Fingerling to Marketable Size Fish

(*Clause* 2.3)

Sl No.		Raising of Fry to Fingerling		Raising of Fingerling to Table Size		
		Fingerling Rearing Cage Hapa	Bird Protection Net	Cage Grow Out Net	Cage Outer Predator Net	Bird Protection Net
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Walking Platform	Dimension: 500 mm×500 mm ×400 mm (L × W × H) a) Weight: 7.0 Kg/ pc ± 0.3 Kg/pc b) Load capacity: 325 Kg/m^2 c) Raw material: HMWHDPE d) Preference temperature: up to 60°C e) Material: Modular HDPE Buoys fitted with non-metallic nuts and bolts f) Must have provision of handrails and cage net loops for easy installation. g) Colour: Blue, orange, grey or as per choice. h) Material: HDPE j) Surface having chequered finish as anti-skid protection. k) Minimum material wall thickness: 4 mm approx.				
ii)	Hand Rails	The cage frame is fitted with MS hand rails of 1.25 inch and lined with dual layer of PP ropes of 20 mm diameter to enhance the safety of the user and it also serves as an additional support while walking. Height: 3 feet minimum.				
iii)	Anchoring Provision	Weights of 50 kg provided for suspension on diagonally opposite sides of frame with 14 mm diameter nylon rope. Minimum anchoring 315 kg. However, the supplier has to put the anchoring as per site requirements and the weight may go up beyond the said figure				
iv)	Shape	Rectangular	Rectangular	Rectangular	Rectangular	Rectangular
v)	Size	6 m × 4 m	6 m × 4 m	6 m × 4 m	As per layout	6 m × 4 m
vi)	Depth	3 m	3 m	4 m	5 m	4 m
vii)	Bottom Position	Closed flat	Closed flat	Closed flat	Closed flat	Closed flat
viii)	Material Specification	Nylon knotless black 210D/18ply/10 mm full mesh.	HDPE knotted 210D/8ply/26m m full mesh The net will be provided with necessary loops to ensure propertying on the four corners	Nylon knotless Black 210D/18ply/ 20-24 mm full mesh	HDPE knotted 210 D/18ply/ 30 mm full meshes.	HDPE knotted 210D/8ply/26 mm full mesh.

Table 4 Material Specification for Frame Fabrication

(*Clause* 2.4)

Sl No.	Material	Requirements	Advantage	Disadvantage
(1)	(2)	(3)	(4)	(5)
i)	Bamboo	Should last for at least 3 years. 7.5 metres long and 8-9 cm in diameter at the base are best suited to make the frame.	Cheaper than others and locally available	Underwater portion does not last long
ii)	GI/MS	Should last for more than 18-20 years. 1.5-2.0 m diameter, 6.0 m long, 3.15-4.0 mm thickness	Long lasting	Long lasting

2.6 Selection of Stocking Materials/Fish Seed and Stocking

Many species are suitable to grow in cages. The present objective dictates to produce fingerlings primarily of Indian major carps (IMC) and to some extent to grow some common carp (Cyprinus carpio) and grass carp (Ctenopharyngodon idella) provided the food niches are sufficient enough for their further growth after stocking in the reservoir. Fish seed specification to be used is given in Table 5.

Table 5 Fish Seed Specification

(*Clause* 2.6)

Sl No.	Aspects	Specification
(1)	(2)	(3)
i)	Stocking Size	a) Carps: ≥ 8 – 10 cm b) Catfishes, Murrels and Perches: ≥ 4 – 5 g
ii)	Seed Quality	a) Large effective population size of broodstock fishes (Ne): At least 50 brood fish pairs. b) Permissible level of inbreeding accumulation: ~1 percent per generation. c) Family Selection based breeding. Use of Factorial Mating design. d) A centralized fish seed certification system necessary.
iii)	Seed Purity	a) Monoculture of preferred/desirable fishes at hatchery level. b) Community breeding of multiple fish species in the same breeding tank must be stopped. c) A centralized fish seed certification system necessary.
iv)	Seed Price	a) Periodic market survey required for determining minimum fish seed prices feasible and adjustment of current fish seed price accordingly. b) Fingerling sale strategy modification: from 'per piece' basis to 'per kg' basis. c) A centralized fish seed certification system necessary.
v)	Stocking Strategy	a) Compulsory and heavier stocking of fish seed within enclosures installed in inland waters. b) For open waters, post monsoon stocking (Sept-Oct) and premonsoon harvesting (May-Jun) cycle to be followed. Diversified and compatible species mix of local/commercial importance need to be assorted in the fish seed batch. c) Avoid stocking bottom dwelling fishes in waters with >10 m average depth during pre-monsoon months. d) Staggered stocking during post-monsoon months. Observance of closed season after stocking. e) Mesh size regulations during harvesting.

Stocking for raising fingerlings in cages in Indian reservoirs, healthy carp fry measuring 15-20 mm long, or even up to 25 mm, are best suited. Advanced fry more than 45 mm should be avoided for cage culture to fingerling size, as they routinely are affected by fungal diseases. A stocking density of species specific is indicated in Table 5. Fry should be shifted late in the day or early in the evening, conditioning at the site of procurement and acclimatization at the site of release in cages. Conditioning is required to transport the fry with empty stomachs, as the ammonia and carbon dioxide generated by fish waste may prove lethal to fry during transport. Prior to release, fry are subjected to some prophylactic measures in a 3-5 percent salt solution as well as potassium permanganate (5-6 percentage) for 1 to 2 min and then released into the cage water. Recommended stocking density of different species of fishes is given in Table 6.

Table 6 Species Wise Stocking Density for Cages

(*Clause* 2.6)

Sl No.	Species	Numbers/m^3 (Fry to Fingerlings)	Numbers/m^3 (Fingerling to Table Fish)
(1)	(2)	(3)	(4)
i)	*L. rohita*	250	25-30
ii)	*C. catla*	200-250	20-25
iii)	*C. carpio*	250	25-30
iv)	*M. rosenbergii*	30-40	15-20
v)	*A. testudineus*	150-200	40-50
vi)	*C. batrachus*	100-200	30-40
vii)	*P. hypothalamus*	250-300	50-60
viii)	*L. bata*	300-350	70-100
ix)	*GIFT Tilapia.*	150-200	40-50

2.7 Grow-out Period-growth Monitoring

Raising carp fingerlings in cages generally requires 60 to 120 days, depending on the water body's natural productivity and the quality of supplementary feed. For fingerlings to table fish, secondary thinning is required after grow out of 100 g size of each species for further growth to the promoted. For Indian major carps, a table fish of 500 – 600 g size would be obtained within 6-7 months after attaining of 100 g size whereas, in case of Pangasius, the growth is faster than carps with more congregation and >750 size would be attained within 4-5 months if 100 g sized fish are stocked in cages. Recommendations for fish feeding is given in Table 7.

Table 7 Fish Feeding Parameters

(*Clause* 2.7)

Sl No. (1)	Aspects (2)	Requirements (3)
i)	Feeding Strategy	a) Supplementary feeding (fish feed) only given within cages. b) Feed administered through a combination of floating feeds and bag feeding @3-4 bags/ha c) Feed twice a day in equal half splits (09:30 am and 4:00pm) d) Provision of locally eutrophic zones and fish aggregating devices like submerged branch pile, floating weed refuge to be made in open waters @15-25 percent of the total water area to serve as feeding grounds
ii)	Feed Quality	a) Protein content: below 30 percent for carps, below 35 percent for catfishes, murrels and perches. P: E ratio: Between 80-90 mg/Kcal. b) Gross energy: Between 3-4 Kcal/ gram of feed. c) FCR: must be below 1.75-2 (*Max.*) d) Pellet size: 1-2 mm (fry to fingerling) 2-5 mm diameter (fingerling to table size depending on the species).
iii)	Feed Quantity	a) Scientific approach: Daily ration @ 3-5 percent for fry to fingerling and 2-3 percent for fingerling to table size of the total biomass (within cages). Feed quantity maintained through increments after monthly sampling. b) Fixed. Feeding during winter months should be minimized (1percent total biomass)
iv)	Feed Price	a) Periodic market survey required for determining minimum fish feed prices feasible and adjustment of current fish feed price accordingly. b) A cheaper feed whose FCR value exceeds 2 should not be chosen. In such case, a feed with higher price and FCR below 1.75 must be chosen.

2.8 Stock Management

2.8.1 *Culture of Pangasianodoan hypoththalmus*

The fish seed for stocking should be sourced from authentic and reliable agencies, subject to regulatory requirements. Proper records on seed sourcing should be maintained and the seed should be quarantined and acclimatized and bathed in 3 mg/L $KMnO_4$ (as prophylactic treatment on need basis) before stocking. The size at stocking and optimum stocking density vary according to requirements, depending on growth and survival. However, stocking density for *P. hypophthalmus* range from 500 to 700 $/m^3$ of 20 mm size fry for rearing to fingerlings. For grow-out, the stocking density is in the range of 60 to $100/m^3$ of fingerlings (50-60 mm size). The stocking material is better transported to the cage site in water loaded open tank with frequent stirring. Stock maintenance involves periodic sampling to assess the growth and general health condition. The culture period of *P. hypophthalmusis* generally 7 – 8 months.

For raising fingerlings of Indian major carps, fry measuring above 25 mm length are suitable for rearing in cages. The size at stocking and stocking density of Indian major carps and other indigenous species shall be need-based as these have not been standardized yet. To raise fingerlings for culture of Indian major carps, it is always better to stock 50 mm fry as these will grow faster and survival rate would be higher. Harvesting can be done after rearing for 90 days. However, this depends on natural productivity and supplementary feeding. It is helpful if land-based nurseries are available near a reservoir or a cluster of them for rearing fry to fingerlings. The rate of feeding for *P. hypophthalmus* is given in Table 8.

Table 8 Rate of Feeding for *P.hypophthalmus*

(*Clause* 2.8.1)

Sl No. (1)	Stage (2)	Feed (3)	Protein Requirement (4)	Feeding Rate (Percent of Fish Body Weight) (5)
i)	Fry to fingerling	Crumble floating feed (0.5 - 1.0 mm)	30 to 35 percent	Less than 10 percent body weight, 4-5 times a day
ii)	Fingerling to table Fish	Pellet floating feed (above 1.0 mm)	First 2 months, 5 percent body weight @ twice a day. From 3rd to 5th month 3 percent body weight @ twice a day or as required. From 6th month onward 2 percent body weight @ twice a day or as required.	—

2.8.2 *Culture of GIFT Tilapia*

Culture technologies for GIFT Tilapia (*Oreochromis niloticus*) and Sea Bass (*Lates calcarifer*) have been developed. Requirements of cage specification of Tilapia is given in Table 9. Requirements of stock management of Tilapia is given in Table 10 and feeding chart for Tilapia id given in Table 11.

Table 9 Specifications of Net Cage for Tilapia Culture

(*Clause* 2.8.2)

Sl No. (1)	Net Cage Specifications (2)	Fish Weight (3)
i)	Fish net cage without top cover made of HDPE 0.75/16 mm mesh size webbings with rope (Cage size 5m × 5m × 5m)	50 – 15 grams
ii)	Fish net cage without top cover made of HDPE 1.25/20mm mesh size webbing with rope (Cage size 5m × 5m × 5m)	150 -250 grams
iii)	Fish net cage without top cover made of HDPE 1.25/24mm mesh size webbings with rope (Cage size 5m × 5m × 5m)	250 – 500 grams, till harvest

Table 10 Stock Management of Tilapia

(*Clause* 2.8.2)

Sl No. (1)	Items (2)	Requirements (3)
i)	Cage size	5 m × 5 m × 4 m
ii)	Mesh sizes	16 mm, 20 mm, 24 mm
iii)	Body weight, feed pellet size and protein content	50-150 gram -2mm (28 percent protein) 150-500 gram -3mm (28 percent protein) 500-600 gram -4mm (25 percent protein) 600 gram and above -5 mm (22percent protein)
iv)	Stocking density	40/m^3
v)	Cage changing	Fortnightly
vi)	Nursery	Not permitted in reservoirs; minimum stackable size is 50 grams

Table 11 Feeding Chart for Tilapia

(*Clause* 2.8.2)

Sl No. (1)	ABW (g) (2)	Feeding Rate (Percent of Body Weight) (3)	Culture Phase (4)
i)	1-5	8	Nursery rearing
ii)	6-10	6	
iii)	11-15	5.5	
iv)	15-20	4	
v)	20-50	4.0-2.5	
vi)	50-100	2.5-1.7	Grow out rearing
vii)	100-200	1.7-1.3	
viii)	200-300	1.3-1.0	
ix)	300-500	1.0-0.9	
x)	500-700	0.9-0.8	
xi)	>700	1.8-0.6	

2.8.3 *Culture of Sea Bass (Lates Calcarifer)*

Requirements of cage specification for Sea bass are given in Table 12 and Table 13. Feeding chart for Sea bass is given in Table 14.

Table 12 Type and Number of Net Cages required for Sea Bass Culture

(*Clause* 2.8.3)

Sl No. (1)	Particulars of Cage (2)	No. of Cages Required (Percent) (3)
i)	500 PE/8 ply/12 mm (knot to knot)	6
ii)	500PE/8 ply/12mm (knot to knot)	8
iii)	500 PE/8 ply/12 mm (knot to knot)	10
iv)	500PE/8 ply/12mm (knot to knot)	12
v)	500 PE/8 ply/12 mm (knot to knot)	16
vi)	500PE/8 ply/12mm (knot to knot)	23
vii)	500PE/8 ply/12mm (knot to knot)	25

Table 13 Cage Mesh Size and Biomass Capacity for different sizes of Sea Bass

(*Clause* 2.8.3)

Sl No. (1)	Size of Fish (cm) (2)	Weight of Fish (g) (3)	Cage Mesh (mm) (4)	Biomass (kg/cu.m) (5)
i)	10.0-12.0	13.0-23.0	12.0	2.5-3.0
ii)	12.0-14.0	23.0-53.5	12.0	3.0-3.5
iii)	14.0-16.0	53.5-76.0	16.0	3.5-4.0
iv)	16.0-18.0	76.0-105.0	16.0	4.0-4.5
v)	18.0-20.0	105.0-140.0	20.0	4.5-5.0
vi)	20.0-22.0	140.0-180.0	24.0	5.0-5.5
vii)	22.0-24.0	180.0-230.0	24.0	5.5-6.0
viii)	24.0-26.0	230.0-280.0	24.0	6.0-6.5
ix)	26.0-30.0	280.0-350.0	32.0	6.5-7.0
x)	30.0-32.0	350.0-420.0	32.0	7.0-7.5
xi)	32.0-34.0	420.0-500.0	38.0	7.5-8.0
xii)	34.0-36.0	500.0-600.0	38.0	8.0-9.0
xiii)	36.0-38.0	600.0-700.0	38.0	9.0-10.0
xiv)	38.0-40.0	700.0-820.0	44.0	10.0-11.0
xv)	40.0-43.0	820.0-1 000.0	44.0	11.0-12.0

2.9 Fish Health Monitoring

As fish health monitoring involves maintaining hygienic and healthy culture environments. It is important to screen the seeds for better health through routine tests before stocking into the cages. Further specific pathogen tests shall be made for seeds of seabass, GIFT, carps and prawns before stocking to the cages. Preventive measures such as prophylactic treatment before stocking, regular monitoring of stock and periodic cleaning of cages shall be practiced to avoid outbreak of diseases and stock loss. Regular monitoring health card shall be reviewed. Routine checks of fish health preventing massive fry loss. Fish health can be easily checked by monitoring fry response when feed is applied. Signs of ill health include surfacing, lesions, rashes, spots, lumps, excessive mucus formation, woolly mat formation, bulging eyes, and fin and tail erosion. Appropriate prophylactic measures should be applied as necessary and at least fortnightly. Remove the fry from the cages and soak them for 2 min in a 3-5 percent salt solution followed by 5-8 percent potassium permanganate solution to eradicate ecto-parasites. A 20-30 percent potassium permanganate solution may be spread on the water surface inside the cages. At times, a lime solution may be spread inside the cages to clear the water.

Table 14 Feeding Chart of Sea Bass

(*Clause* 2.8.3)

Sl No. (1)	Size of Fish (cm) (2)	Average Weight (g) (3)	Feed type (4)	Pellet Size (mm) (5)	Feeding Rate (Percent Body Weight) (6)
i)	9-10	9.7-13.0	Floating	2.0-2.2	5.0
ii)	10-12	16.0-23.0	Floating	3.0	4.8
iii)	12-16	23.0-53.5	Floating	4.0	4.6
iv)	16-18	53.5-76.0	Floating	4.0	4.4
v)	18-20	76.0-105.0	Floating	6.0	4.2
vi)	20-22	105.0-140.0	Floating	6.0	3.8
vii)	22-24	140.0-180.0	Floating	8.0	3.6
viii)	24-26	180.0-230.0	Floating	8.0	3.2
ix)	26-28	230.0-280.0	Floating	10.0	3.0
x)	28-30	280.0-350.0	Floating	10.0	2.8
xi)	30-32	350.0-420.0	Floating	10.0	2.6
xii)	32-24	420.0-500.0	Floating	12.0	2.4
xiii)	34-36	510.0-600.0	Floating	12.0	2.2
xiv)	36-38	600.0-700.0	Floating	12.0	2.0
xv)	38-40	700.0-820.0	Floating	14.0	1.8
xiv)	40-43	820.0-1 000	Floating	14.0	1.8

A record on incidence of fish disease and control measure adopted including medicines used should be maintained. It is recommended that drugs and chemicals should be administer only in consultation with qualified fish health scientist. The record of such drugs/ chemicals administered, dosage, time period etc. shall be maintained.

2.10 Removal and Release

As fry grow at different rates, they must be segregated by size to prevent the slower growers from falling further behind. Fingerlings that reach the length of 70-80 mm should be harvested, thinning the cage population to allow the smaller fry to grow more quickly. Harvesting generally occurs in three batches as fingerlings approach 80 mm in length. Records should be kept of the length and weight of harvested fingerling batches. Cage culture of fingerlings in the reservoir that is to be stocked saves transport costs and minimizes fingerling mortality. Using the procedure described above should yield a fingerling recovery rate of at least 70 percent.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Fish, Fisheries and Aquaculture Sectional Committee, FAD 12

Organization	*Representative(s)*
Indian Council of Agricultural Research, New Delhi	Dr Joykrushna Jena, (***Chairperson***)
Central Inland Fisheries Research Institute, Barrackpore	Dr Bijay Kumar Behera Shri Dharmendra Kumar Meena (*Alternate*)
Central Institute of Brackish Water Aquaculture, Chennai	Dr K. Ambasankar Dr Subhendu Kumar Otta (*Alternate*)
Central Institute of Fisheries Education, Mumbai	Dr Gopal Krishna Dr B. B. Nayak (*Alternate*)
Central Institute of Fisheries Technology (CIFT), Cochin	Dr K. Ashok Kumar Dr Madhusudana Rao (*Alternate*)
Central Institute of Fresh Water Aquaculture, Bhubaneswar	Dr Kedar Nath Mohanta Dr P. C. Das (*Alternate*)
Central Marine Fisheries Research Institute, Kochi	Dr A. K. Abdul Nazar
Coastal Aquaculture Authority, Chennai	Prof R. Jayaraman Shri S. Mani (*Alternate*)
Defence Food Research Laboratory, Mysore	Dr N. Gopalan
Export Inspection Council of India, New Delhi	Shri R. M. Mandalik
Fisheries Division, DAHD&F, Min. of Agriculture, GoI, New Delhi	Shri Paul Pandian Shri I. A. Siddiqui (*Alternate*)
Food Safety and Standards Authority of India, New Delhi	Ms Vinita Verma Dr Rajesh Kumar (*Alternate*)
National Fisheries Development Board, Hyderabad	Executive Director (Technical)
National Institute of Fisheries Post Harvest Technology and Training (NIFPHATT), Cochin	Shri Varghese John Mr Kamal Raj (*Alternate*)
Sea Food Exporters Association of India, Alleppy	Shri Norbert Karikkassery
Society of Aquaculture Professionals, Chennai	President
The Marine Products Export Development Authority (MPEDA), Kochi	Joint Director Deputy Director (QC) (*Alternate*)
Kerala University of Fisheries and Ocean Studies, Kochi	Dr T. V. Sankar
All India Shrimp Hatchery Association	Shri D. Ramraj Shri K. Madhusudan Reddy (*Alternate*)
Director General, BIS (*Ex-officio Member*)	Shri P. Rajesh, Head (Food and Agriculture Department)

Member Secretary

Ms Navita Yadav

Scientist ‘C’ (Food and Agriculture Department), BIS

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